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(54) **METHOD AND SYSTEM FOR ESTABLISHING A QUEUING SYSTEM INSIDE A MESH NETWORK**

(71) Applicant: **Broadcom Corporation**, Irvine, CA (US)

(72) Inventors: **Alexander Garland MacInnis**, Los Altos, CA (US); **Thomas Quigley**, Franklin, NC (US); **Arya Reza Behzad**, Los Altos, CA (US); **Jeyhan Karaoguz**, Irvine, CA (US); **John Walley**, Ladera Ranch, CA (US); **Mark Buer**, Payson, AR (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

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(60) Provisional application No. 60/950,935, filed on Jul. 20, 2007.

(51) **Int. Cl.**
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H04W 28/14 (2009.01)

(Continued)

(52) **U.S. Cl.**
CPC ***H04W 28/14*** (2013.01); ***H04L 47/30*** (2013.01); ***H04L 47/32*** (2013.01); *H04W 84/18* (2013.01); *H04W 88/04* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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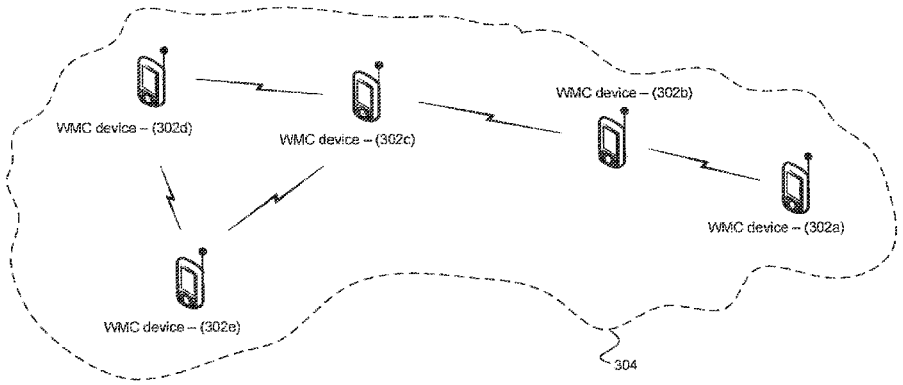
Primary Examiner — Nicholas Sloms
(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

Wireless mobile communication (WMC) devices located in operating proximity of each other may be enabled to form a mesh (ad hoc wireless) network. WMC devices in a mesh network may form a queuing system wherein each WMC device may store data forwarded to and/or from other WMC devices in the mesh network. Each WMC device in the mesh network may have different queuing capability based on a plurality of factors that may comprise internal factors such as processing, storage, power, and/or connectivity. The mesh network may comprise an internal addressing scheme that may enable utilization of the queuing system whether or not WMC devices in the mesh network are communicatively coupled to external networks.

20 Claims, 6 Drawing Sheets



(51) **Int. Cl.**

H04L 12/835	(2013.01)
H04L 12/823	(2013.01)
H04W 84/18	(2009.01)
H04W 88/04	(2009.01)

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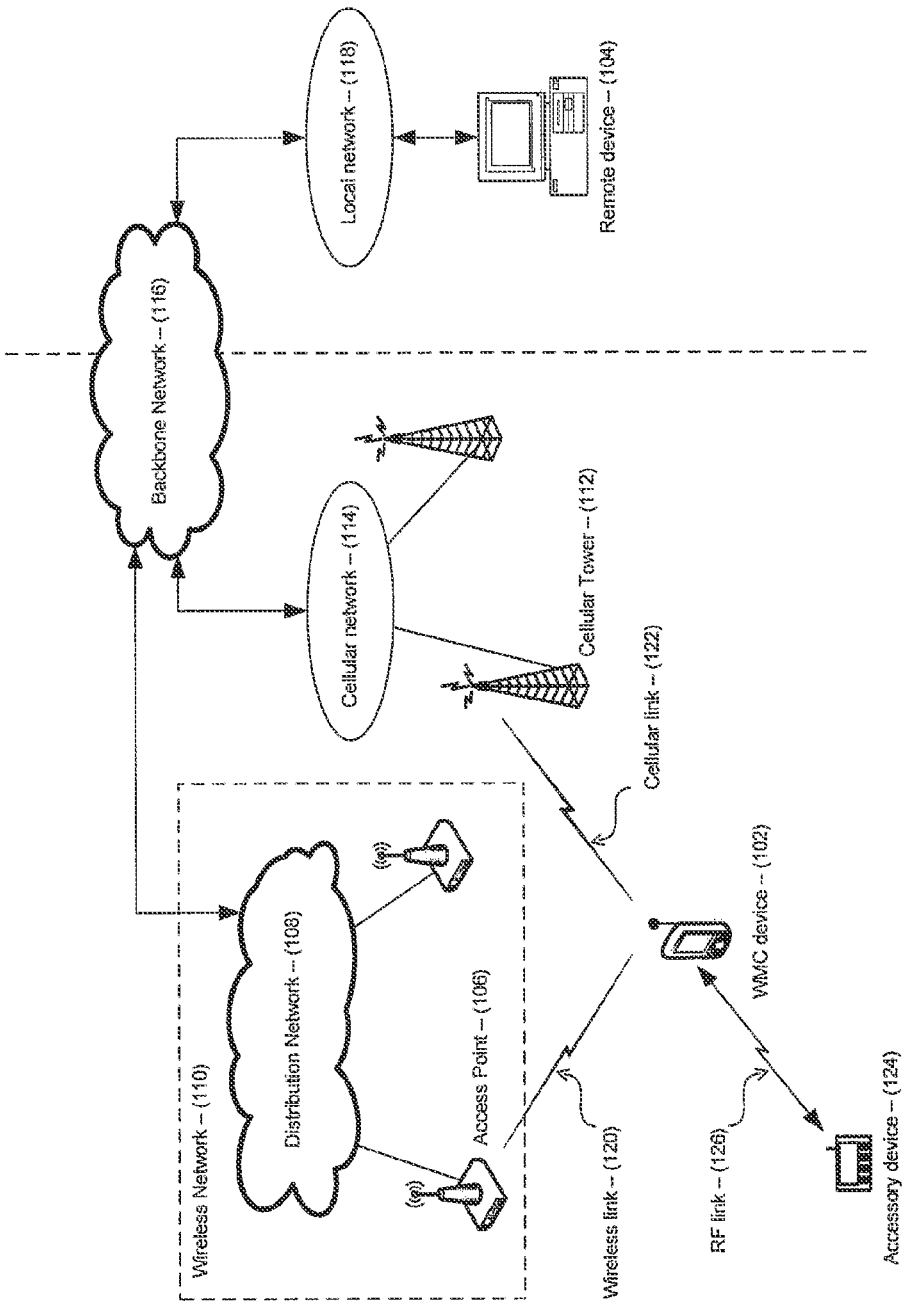
Local network – (118)
Remote device – (104)
Backbone Network – (116)
Cellular network – (114)
Cellular Tower – (112)
Cellular link – (122)
Wireless Network – (110)
Distribution Network – (108)
Access Point – (106)
Wireless link – (120)
WMC device – (102)
RF link – (126)
Accessory device – (124)

FIG. 1A

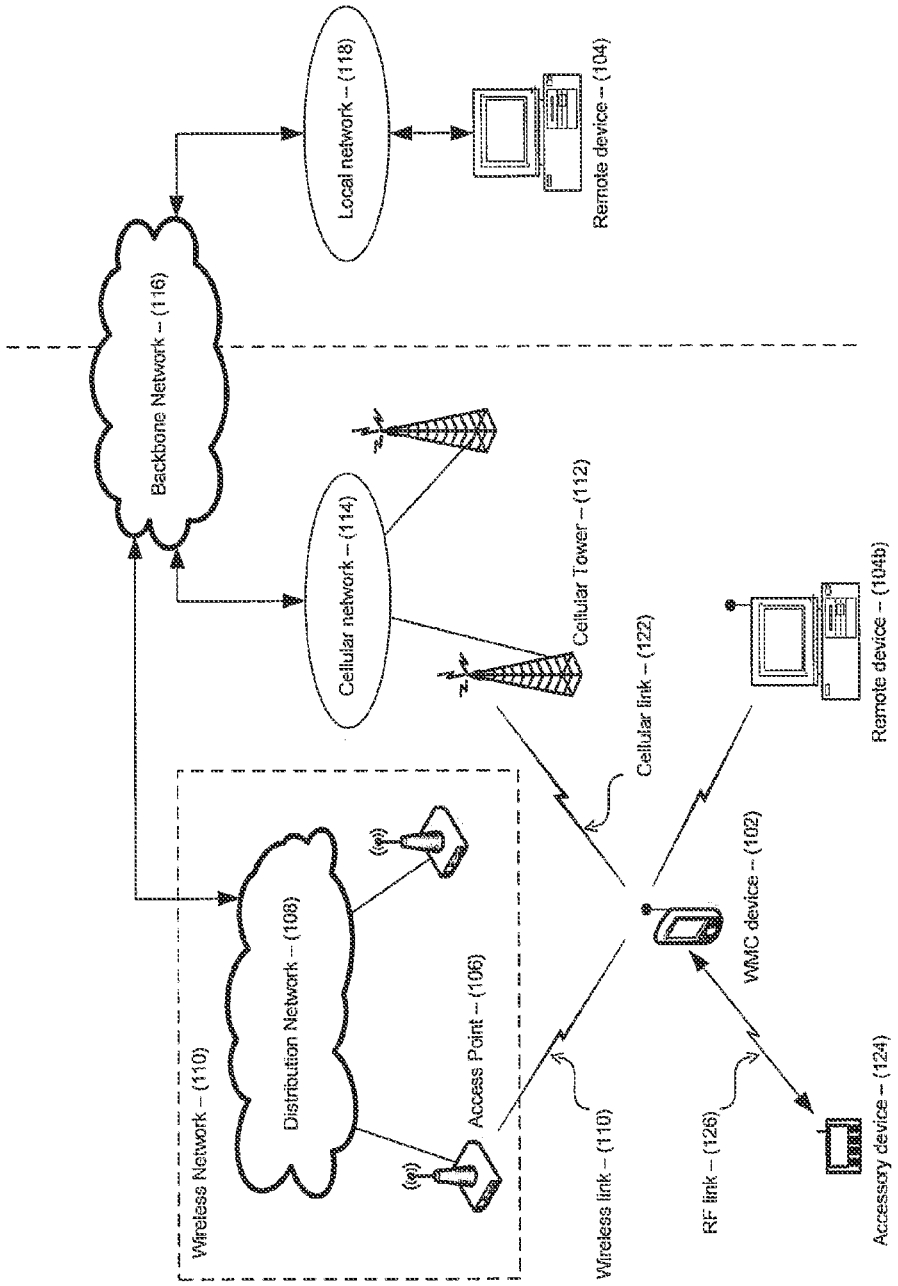
Local network – (118)
Remote device – (104)
Backbone Network – (116)
Cellular network – (114)
Cellular Tower – (112)
Cellular link – (122)
Remote device – (104b)
Wireless Network – (110)
Distribution Network – (108)
Access Point – (106)
WMC device – (102)
Wireless link – (110)
RF link – (126)
Accessory device – (124)

FIG. 1B

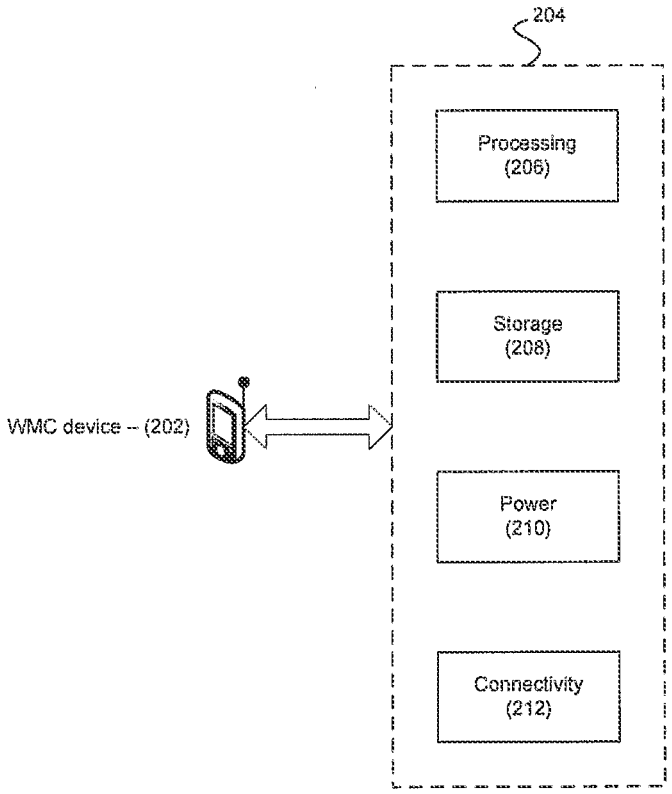
204
Processing
(206)
Storage
(208)
Power
(210)
Connectivity
(212)
WMC device – (202)

FIG. 2

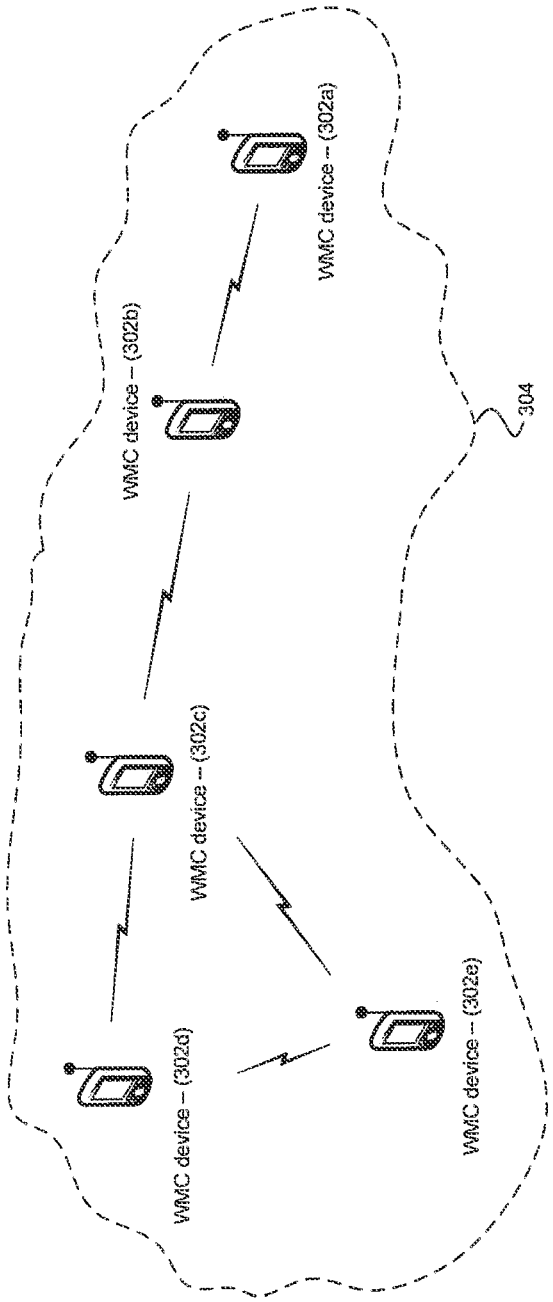
WMC device – (302a)
WMC device – (302b)
304
WMC device – (302c)
WMC device – (302d)
WMC device – (302e)

FIG. 3

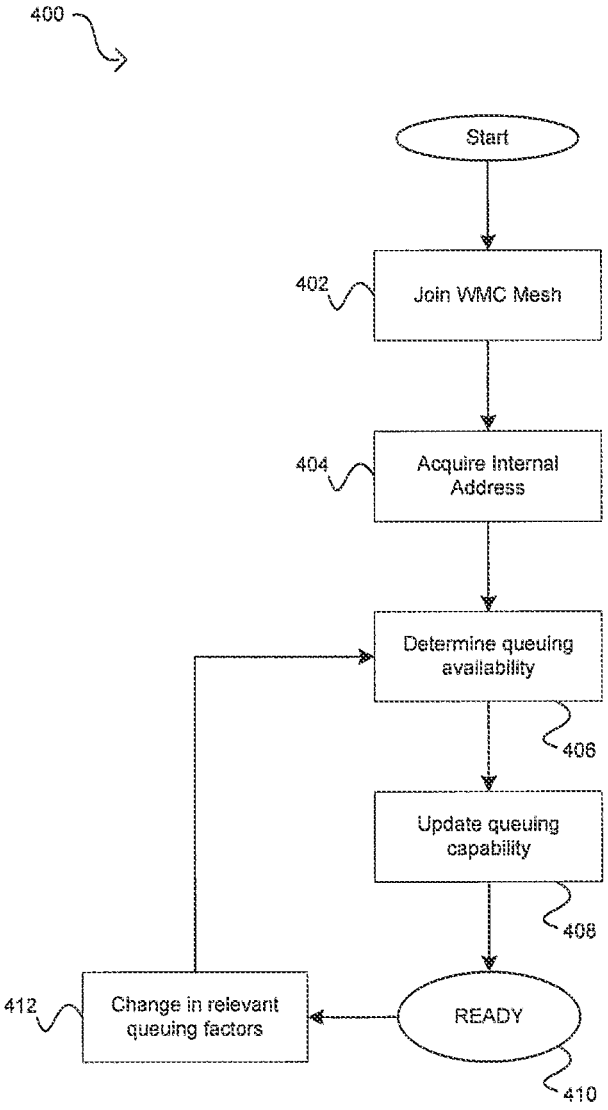
400
Start
402
Join WMC Mesh
404
Acquire Internal Address
Determine queuing availability
406
Update queuing capability
408
412
Change in relevant queuing factors
READY
410

FIG. 4A

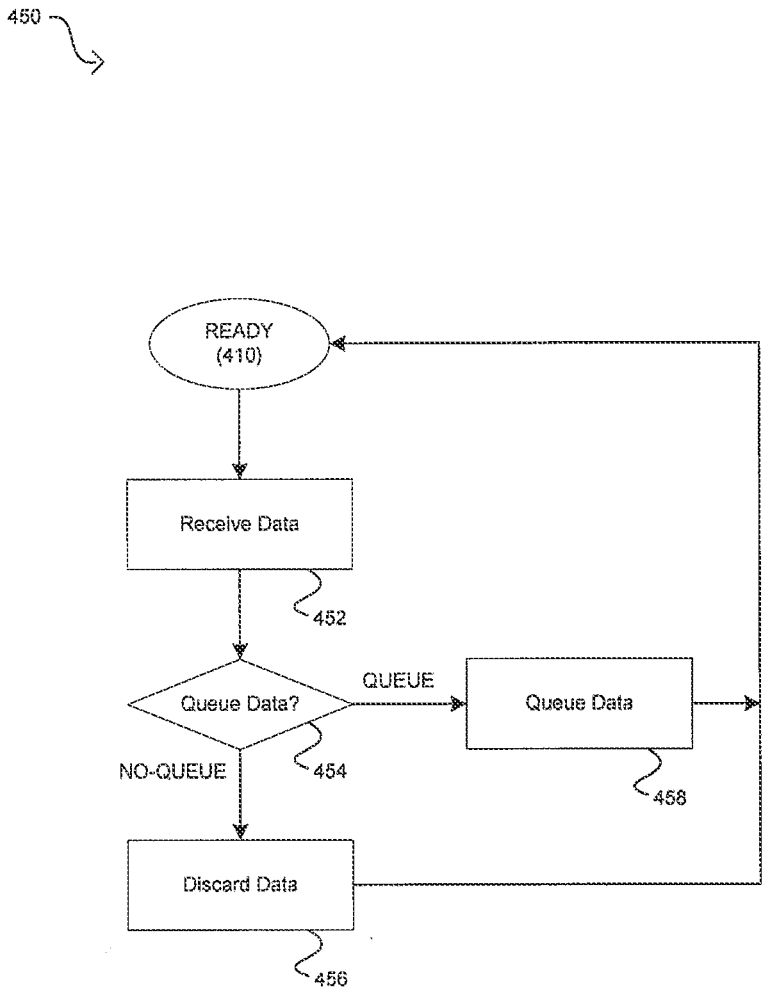
450
READY
(410)
Receive Data
452
Queue Data?
QUEUE
Queue Data
454
458
NO-QUEUE
Discard Data
456

FIG. 4B

METHOD AND SYSTEM FOR ESTABLISHING A QUEUING SYSTEM INSIDE A MESH NETWORK

CROSS-REFERENCE TO RELATED APPLICATIONS/INCORPORATION BY REFERENCE

This patent application is a continuation of copending U.S. utility application entitled, "Method and System for Establishing a Queuing System inside a Mesh Network," having Ser. No. 11/864,215, filed Sep. 28, 2007, which makes reference to, claims priority to and claims benefit from U.S. Provisional Application Ser. No. 60/950,935 filed on Jul. 20, 2007. The above stated applications are hereby incorporated herein by reference in their entireties.

FIELD OF THE INVENTION

Certain embodiments of the invention relate to wireless devices. More specifically, certain embodiments of the invention relate to a method and system for establishing a queuing system in a mesh network.

BACKGROUND OF THE INVENTION

The field of wireless communication has seen dramatic growth the last few years. In today's world, most people use their wireless devices for various purposes, business and personal, on a constant and daily basis. Society is truly becoming a wireless one. Numerous wireless solutions have been introduced, and have made a tremendous impact on everyday life.

For example, the use of Wireless Personal Area Networks (WPAN) has been gaining popularity in a great number of applications because of the flexibility and convenience in connectivity they provide. WPAN systems generally replace cumbersome cabling and/or wiring used to connect peripheral devices and/or mobile terminals by providing short distance wireless links that allow connectivity within very narrow spatial limits (typically, a 10-meter range). WPAN may be based on standardized technologies, for example Class 2 Bluetooth® (BT) technology. While WPAN may be very beneficial for certain applications, other applications may require larger service areas and/or capabilities.

To satisfy such needs, other technologies have been developed to provide greater wireless service. Wireless Local Area Networks (WLAN) systems may operate within a 100-meter range, for example. In contrast to the WPAN systems, WLAN provide connectivity to devices that are located within a slightly larger geographical area, such as the area covered by a building or a campus, for example. WLAN systems are generally based on specific standards, for example IEEE 802.11 standard specifications, and typically operate within a 100-meter range, and are generally utilized to supplement the communication capacity provided by traditional wired Local Area Networks (LANs) installed in the same geographic area as the WLAN system.

Other forms of wireless solutions have evolved from traditional land-based communication technologies. For instance, cellular phones have become just about an absolute necessity in today's world. While cellular technology was merely intended to add an element of mobility to the traditional telephony service, this technology has grown beyond that initial purpose. Many modern cellular technologies, including such technologies as GSM/GPRS/EDGE, UMTS, and CDMA2000, incorporate substantial data capabilities. Most of today's cellular services include such features as text messaging, video streaming, web browsing . . . etc.

Mobile wireless devices with various wireless technologies are another trend in the wireless world. For instance, WLAN systems may be operated in conjunction with WPAN systems to provide users with an enhanced overall functionality. For example, Bluetooth® technology may be utilized to connect a laptop computer or a handheld wireless terminal to a peripheral device, such as a keyboard, mouse, headphone, and/or printer, while the laptop computer or the handheld wireless terminal is also connected to a campus-wide WLAN network through an access point (AP) located within the building.

Devices aimed at taking advantage of the capabilities of wireless networks may be described as Wireless mobile communication (WMC) devices. Today's WMC devices may comprise such devices as cellular phones, PDA's, laptops, and/or other devices.

One of the issues that may arise with the use of WMC devices is the availability of wireless connectivity. Because WMC devices are typically use-on-the-move type devices, a WMC device, due to its user's movement, may be located outside the of wireless connectivity coverage area. For example, with such devices as mobile phones, it is not unusual for a user to drive out of cellular networks coverage area, especially when driving between towns. This may result in dropped calls or significantly degraded reception and/or services.

Further limitations and disadvantages of conventional and traditional approaches will become apparent to one of skill in the art, through comparison of such systems with some aspects of the present invention as set forth in the remainder of the present application with reference to the drawings.

BRIEF SUMMARY OF THE INVENTION

A system and/or method is provided for establishing a connection outside a mesh by including network connectivity information in router configuration messages, substantially as shown in and/or described in connection with at least one of the figures, as set forth more completely in the claims.

These and other advantages, aspects and novel features of the present invention, as well as details of an illustrated embodiment thereof, will be more fully understood from the following description and drawings.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

FIG. **1**A is a block diagram that illustrates an exemplary model for setup that comprises a wireless mobile communication (WMC) device and a remote device, which may be utilized in accordance with an embodiment of the invention.

FIG. **1**B is a block diagram that illustrates an exemplary model for setup that comprises a wireless mobile communication (WMC) device communicating directly via a wireless connection with a remote device, which may be utilized in accordance with an embodiment of the invention.

FIG. **2** is a block diagram that illustrates an exemplary wireless mobile communication (WMC) device that may be enabled to queue data, which may be utilized in accordance with an embodiment of the invention.

FIG. **3** is a block diagram that illustrates a plurality of WMC devices forming a mesh network, which may be utilized in accordance with an embodiment of the invention.

FIG. **4**A is a flow chart that illustrates a WMC device joining a mesh network and its queuing system, in accordance with an embodiment of the invention.

FIG. **4**B is a flow chart that illustrates a WMC device in a mesh network performing queuing operations, in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Certain embodiments of the invention may be found in a method and system for establishing a queuing system in a mesh network. WMC devices may be enabled to communicate directly with other WMC devices that may be located within proximity of each other, thereby allowing peer-to-peer connectivity. WMC devices' peer-to-peer communication may be device-specific and thus limited to a class of devices based on type and/or make. Alternatively, a WMC devices' peer-to-peer connectivity may also be based on a standardized wireless connectivity interface, for example Bluetooth®. Such WMC devices peer-to-peer connectivity may be utilized to form a mesh (ad hoc wireless) network. WMC devices in a mesh network may form a queuing system wherein each WMC device in the mesh network may queue data forwarded from and/or to other WMC devices in the mesh network. The queuing system may be utilized to facilitate messaging between WMC devices in the mesh network and other WMC devices in the mesh network and/or external entities. A WMC device queuing availability may be based on a plurality of factors that may comprise processing load, storage space, power resources, and/or both internal and external connectivity of the device. An internal addressing scheme may be utilized in the mesh network wherein each WMC device in the mesh network may be assigned a unique internal address. The internal addressing scheme may be utilized in queuing operations.

FIG. **1**A is a block diagram that illustrates an exemplary model for setup that comprises a wireless mobile communication (WMC) device and a remote device, which may be utilized in accordance with an embodiment of the invention. Referring to FIG. **1**A, there is shown a WMC device **102**, a remote device **104**, an access point **106**, a distribution network **108**, a wireless network **110**, a cellular tower **112**, a cellular network **114**, a backbone network **116**, a local network **118**, a wireless link **120**, a cellular link **122**, an accessory device **124**, and a RF link **126**.

The WMC device **102** may comprise suitable logic, circuitry and/or code that may enable performing wireless mobile communication. For example, the WMC device **102** may be utilized to perform voice, video and/or text message peer-to-peer communication. A WMC device may comprise an end user device or an end user terminal device comprising a user interface. The WMC device **102** may also perform additional functionality comprising internet browsing, and/or video streaming.

The remote device **104** may comprise suitable logic, circuitry and/or code that may be enabled to communicate to with the WMC device **102**. The invention may not be limited to a specific remote device, but may comprise, for example, a general purpose processing device, a specialized processing device, a specialized peripheral device, or any combination of suitable hardware, and/or code, which may be enabled to perform a job requested by the WMC device **102**. For example, the remote device may comprise a home PC comprising fast processing subsystems and increased memory space. Such home PC may be better suited to perform processing and/or storage intensive tasks. For example, where necessary and/or feasible, the WMC device **102** may utilize the remote device **104** for Internet searches and/or for secure storage of data that may be created and/or maintained in the WMC device **102**.

The wireless network **110** may comprise a plurality of the access point **106**, the distribution network **108** and suitable logic, circuitry and/or code that may enable implementing a functional block corresponding to a wireless technology. Exemplary wireless technology may comprise for example the IEEE 802.11 (WLAN) or WiMAX (IEEE 802.16) architecture. The access point **106** may comprise suitable logic, circuitry, and/or code that may be utilized as access point necessary for the WMC device **102** to access the wireless network **110**. The distribution network **108** may comprise suitable logic, circuitry, and/or code that may be adapted to operate as a backbone network that may be responsible for transport and link functionality for plurality of access points in the wireless network **110**.

The cellular network **114** may comprise plurality of the cellular tower **112**, and suitable logic, circuitry and/or code that may enable implementing a functional block corresponding to a cellular technology. Exemplary cellular technology may comprise cellular technologies that enable data services, including but not limited to, CDMA, WCDMA, CDMA1000, HSDPA, GSM, GPRS, EDGE, and UMTS.

The accessory device **124** may comprise suitable logic, circuitry and/or code that may enable performing some accessory functionality in conjunction with the use of the WMC device **102**. For example, the accessory device may comprise a hands-free headset. The WMC device **102** may interact with the accessory device **124** over a short-range RF link **126**. The RF link **126** may be based on a standardized technology for inter-device short range communication. For example, the RF link may correspond to a Bluetooth® connection or ZigBee connection between the accessory device **124** and the WMC device **102**.

The local network **118** may comprise suitable logic, circuitry and/or code that may enable local connectivity. This local connectivity may comprise use of Local Area Network (LAN) technologies that enable data services, including but not limited to, IEEE 802.3 Ethernet. Other technologies may comprise WiMAX.

The backbone network **116** may comprise suitable logic, circuitry, and/or code that may be adapted to provide overall system connectivity between sub-networks. The wired network **116** may be enabled to interact with, and connect different wired and/or wireless technologies. For example, the backbone network may comprise a standard telephony network (POTS) that may enable data connectivity between different interface nodes linking wired and/or wireless networks comprising WLAN networks, WiMAX networks, cellular networks, and/or LAN networks.

In operation, the WMC device **102** may utilize the wireless link **120** to access the wireless network **110** via the access point **106**. The WMC device **102** may also utilize the cellular link **122** to access the cellular network **114** via the cellular tower **112**. The WMC device **102** may attempt to communicate with the remote device **104** via the wireless network **110** through the access point **106** and the distribution network **108**. The distribution network **108** may enable transport and/or routing of messages and/or data sent from, and to the WMC device **102**. The backbone network **116** enables connectivity between local networks, for example wireless network **110**, and cellular network **114**. The remote device **104** may receive communication from the WMC device **102** by interacting with the backbone network **116**. Necessary protocol-based operations may be performed to

facilitate the transmission of information through all the different components. This may comprise use of such protocols as IP, and SS7.

Once connected, the WMC device **102** may communicate with the remote device **104**. The WMC device may attempt to exchange data, information, and/or messaging with the remote device **104**. The data exchange between WMC device **102** and the remote **104** may be on behalf of another WMC device that may be in close operational proximity of the WMC device **102**. The WMC device **102** may temporarily loss connectivity with the remote device **104**. The loss of connectivity between the WMC device **102** and the remote device **104** may be caused, for example, by loss of the wireless link **120** and/or loss of the cellular link **122**. The WMC device **102** may queue data destined for the remote device **104** during times of loss of connectivity between the two devices. Once the connectivity between the WMC device **102** and the remote device **104** is re-established, the WMC device **102** may transfer queued data to the remote device **104**. The re-establishment of the connectivity between the WMC device **102** and the remote device **104** may be due, for example, to re-establishment of the wireless link **120** and/or the cellular link **122**.

FIG. **1**B is a block diagram that illustrates an exemplary model for setup that comprises a wireless mobile communication (WMC) device communicating directly via a wireless connection with a remote device, which may be utilized in accordance with an embodiment of the invention. Referring to FIG. **1**B, there is shown the WMC device **102**, the remote device **104**, the access point **106**, the distribution network **108**, the wireless network **110**, the cellular tower **112**, the cellular network **114**, the backbone network **116**, the wireless link **120**, the cellular link **122**, the accessory device **124**, the RF link **126**, and a remote device **104***b*.

The remote device **104***b* may be similar to the remote device **104**. However, the remote device **104***b* may also comprise suitable logic, circuitry, and/or code that may enable wireless connectivity. The WMC device **102** may communicate directly with the remote device **104***b* via a wireless connection.

In operation, the WMC device **102**, the remote device **104**, the access point **206**, the distribution network **208**, the wireless network **210**, the cellular tower **212**, the cellular network **214**, the backbone network **216**, the accessory device **224**, and the RF link **226** may operate similar to FIG. **1**A. The remote device **104***b* may operate similar to the remote device **104** as described in FIG. **1**A; however, the WMC device **102** may communicate directly with the remote device **104***b* over a wireless connection. The remote device **104***b* may be operated as a stand-alone device, or it may be operated within a compatible network, wherein the remote device may be integrated. The ability to communicate directly with the remote device **104***b* may allow improved utilization of the remote device **104***b* by the WMC device **102**. The direct wireless connection between the WMC device **102** and the remote device **104***b* may enable faster and more reliable communication between the two devices. The improvement may be due to the characteristics of the wireless connection between the remote device **104***b* and the WMC device **102**, for example having greater bandwidth. The improvement may also be due to reduced delays compared to setups where the WMC device **102** may have to communicate with the remote device **104** through plurality of connecting networks and/or entities.

Once the WMC device **102** establishes connection with the remote device **104***b*, the WMC device **102** may utilize the remote device **104***b* similar to the remote device **104**, as substantially described in FIG. **1**A. The WMC device may attempt to exchange data, information, and/or messaging with the remote device **104***b*. The data exchange between WMC device **102** and the remote **104***b* may be done on behalf of another WMC device that may be in close operational proximity of the WMC device **102**. The WMC device **102** may temporarily lose direct connectivity with the remote device **104***b*. The WMC device **102** may queue data destined for the remote device **104***b* during times of loss of direct connectivity between the two devices. Once the direct connectivity between the WMC device **102** and the remote device **104***b* is re-established, the WMC device **102** may transfer queued data to the remote device **104***b*.

FIG. **2** is a block diagram that illustrates an exemplary wireless mobile communication (WMC) device that may be enabled to queue data, which may be utilized in accordance with an embodiment of the invention. Referring to FIG. **2**, there is shown a WMC device **202**, a queuing sub-system **204**, processing resources **206**, storage resources **208**, power resources **210**, and connectivity resources **212**.

The WMC devices **202** may be substantially similar to the WMC device **102**. The WMC device **202** may comprise the queuing sub-system **204**, which may enable performing queuing-related operations. The queuing sub-system **204** may comprise suitable logic, circuitry and/or code that enable queuing of data received from and/or targeted for other WMC devices. The queuing sub-system **204** may utilize and/or depend in its operation on a plurality of resources, which may comprise the processing resources **206**, the storage resources **208**, the power resources **210**, and the connectivity resources **212**.

The processing resources **206** may comprise suitable logic, circuitry and/or code that enable performing processing operations in the WMC device **102**. The processing operations may comprise such operations as data management and/or manipulation in the WMC device **102**. The storage resources **208** may comprise suitable logic, circuitry and/or code that enable performing data storage operations in the WMC device **102**. For example, the storage resources **208** may comprise memory storage resources in the WMC device **102**. The power resources **210** may comprise suitable logic, circuitry and/or code that enable performing power operations in the WMC device **102**. For example, the power resources **210** may comprise battery resources and additional resources necessary to manage utilization of the battery resources in the WMC device **102**. The connectivity resources **212** may comprise available connectivity resources in the WMC device **102**. For example, the connectivity resources **212** may comprise all the wireless connections between the WMC device **102** and other WMC devices and/or wireless networks.

In operation, the WMC device **102** may queue some data. The WMC device **102** ability to queue data may be determined by the queuing sub-system **204**. When queuing data is requested in the WMC device **102**, the queuing sub-system **204** may determine the ability to queue data based on availability of queuing-related resources. For example, the queuing system **204** may determine the availability of the processing resources **206**, the storage resources **208**, the power resources **210**, and the connectivity resources **212**. The queuing sub-system **204** may utilize the processing resources **206** to determine the processing load in the WMC device **102**. Queuing data may comprise data management and/or manipulation, which may cause an increase in processing load in the WMC device **102**. Subsequently, availability of queuing and/or size of data that may be queued may depend on availability of processing that may be

necessary to perform necessary data management and/or manipulation for queuing operations. The queuing sub-system **204** may also utilize the storage resources **208** to determine the storage availability in the WMC device **102**. Queuing data may comprise data storage in the WMC device **102**, which may deplete, for example, storage space in the WMC device **102**. Subsequently, availability of queuing and/or size of data that may be queued may depend on availability of storage that may be necessary to perform necessary data storage for queuing operations. The queuing sub-system **204** may also utilize the power resources **210** to determine the power availability in the WMC device **102**. Queuing data, similar to any other operation performed in the WMC device **102**, may comprise utilizing power in the WMC device **102**. Subsequently, availability of queuing and/or size of data that may be queued may depend on availability of power that may be necessary to perform necessary queuing operations in the WMC device **102**. The queuing sub-system **204** may also utilize the connectivity resources **212** to determine need for queuing in the WMC device **102**. Queuing data may be performed in instances where the WMC device **102** may be expected to forward the queued-data. Subsequently, availability and/or non-availability of connectivity that may be necessary for future transmission of the queued-data may be relevant in determining availability of queuing and/or size of data that may be queued.

FIG. **3** is a block diagram that illustrates a plurality of WMC devices forming a mesh network, which may be utilized in accordance with an embodiment of the invention. Referring to FIG. **3**, there is shown a WMC mesh network **304**, a plurality of WMC devices **302***a*, **302***b*, **302***c*, **302***d*, and **302***e*.

The plurality of WMC devices **302***a*, **302***b*, **302***c*, **302***d*, and **302***e* may be substantially similar to the WMC device **202**. The WMC mesh network **304** may comprise a plurality of WMC devices, and may also comprise suitable logic, circuitry and/or code that may enable forming mesh-like, ad hoc wireless networks of WMC devices.

In operation, the plurality of WMC devices **302***a*, **302***b*, **302***c*, **302***d*, and **302***e* may communicate with each other once the devices are within device-to-device operational proximity. Formation of device-to-devices connections between devices in the plurality of WMC devices **302***a*, **302***b*, **302***c*, **302***d*, and **302***e* may enable formation of the WMC mesh network **304**.

Once the WMC mesh network **304** is formed, the WMC devices in the plurality of WMC devices **302***a*, **302***b*, **302***c*, **302***d*, and **302***e* may attempt to exchange data and/or messages. The data exchange may be utilized to perform communication between WMC devices in the WMC mesh network **304**, or alternatively, the data exchange may be utilized to facilitate communication between a WMC device in the WMC mesh network **304** and some external entity; for example the remote device **104**. Performing data exchange in the WMC network **304** may require data queuing in some of the WMC devices in the WMC mesh network **304**. For example, the WMC device **302***e* may determine that the WMC device **302***a* may be the most likely candidate to forward data from the WMC device **302***e* to some external entity. The WMC device **302***a* may be unable to forward data received from the WMC device **302***e* due to loss of connectivity with the desired external entity. The WMC device **302***a* may queue the data received from the WMC device **302***e* until connectivity with desired external entity may be re-established. Determination of availability of queuing and/or size of data that may be queued may comprise utilizing queuing sub-system **204** in the WMC device **302***a*.

Furthermore, the WMC mesh network **304** may utilize an internal addressing scheme wherein each WMC device in the WMC mesh network **304** may be assigned a unique internal address. For example, the plurality of WMC devices **302***a*, **302***b*, **302***c*, **302***d*, and **302***e* may be assigned unique internal address identities. A WMC device in the WMC mesh network **304** may become communicatively coupled to an external network. For example, the WMC device **302***a* may become communicatively coupled to a WiFi network. The WMC device **302***a* may be assigned an address consistent with the external network. However, the WMC device **302***a* may also retain its internal address identity to enable remaining WMC devices in the WMC mesh network **304** to continue communicating with the WMC device **302***a* for data exchange and/or data queuing purposes.

In an embodiment of the invention, a WMC device joining the WMC mesh network **304** may determine its queuing availability utilizing its queuing sub-system **204**. Furthermore, the queuing availability may continually and/or dynamically be updated as queuing-related resources may change. For example, power resources **210** may be relevant when determining data queuing and/or size of data that may be queued, as described in FIG. **2**. Therefore, changes in the power resources **210** may cause changes in queuing availability in a WMC device in the WMC mesh network **304**.

FIG. **4**A is a flow chart that illustrates a WMC device joining a mesh network and its queuing system, in accordance with an embodiment of the invention. Referring to FIG. **4**A, there is shown flow chart **400**. The flow chart may start when a WMC device comes into operational proximity of other WMC devices forming a mesh network, substantially similar to the mesh described in FIG. **3**. In step **402**, the WMC device may join the mesh network. The WMC device may utilize a specific device-to-device protocol and/or standard-based communication interface to interact with other WMC devices forming the WMC mesh network **304**. For example, the WMC device may utilize, for example Bluetooth® or Ultra-Wideband (UWB) in peer-to-peer communications in joining the WMC mesh network **304**. In step **404**, the WMC device may be assigned an internal address. The WMC mesh network **304** may utilize an internal addressing scheme wherein each WMC device in the WMC mesh network **304** may be assigned a unique internal address to facilitate internal communication between WMC devices within the WMC mesh network **304**. In step **406**, the WMC device may determine its queuing availability. The WMC device may utilize its queuing sub-system **204** in determining availability of data queuing and/or size of data that maybe queued, substantially as described in FIG. **2**. In step **408**, the WMC device may determine its queuing capabilities within the WMC mesh network **304**. The WMC device may utilize its queuing availability, and information derived from internal addressing scheme to determine, for example, devices in the WMC mesh network **304** that the WMC device may be enabled to queue data for, and/or devices that may be utilized for queuing data sent from the WMC device. In step **410**, the WMC device is READY, wherein the WMC device may be actively participating in the WMC mesh operations and may be capable of performing queuing operations in the mesh network **304**. The WMC device may receive data that may be forwarded to and/or from other WMC devices in the WMC mesh network **304**, and/or the WMC device may utilize other devices in the WMC mesh network for queuing of data sent from the

WMC device. In step **412**, the WMC device may determine that changes to queuing-related factors may have occurred. This may comprise changes in the WMC device itself, comprising changes in the processing resources **206**, the storage resources **208**, the power resources **210**, and/or connectivity resources **212**. The process may then proceed back to step **406**, wherein the queuing availability, and subsequently the queuing capability, of the WMC device may be updated.

FIG. **4**B is a flow chart that illustrates a WMC device in a mesh network performing queuing operations, in accordance with an embodiment of the invention. Referring to FIG. **4**B, there is shown flow chart **450**. The process may initiate when a WMC device is in the "READY" state, substantially as described in step **410** of FIG. **4**A, wherein the WMC device may be joined in the WMC mesh network **304**, and may be actively participating in mesh operations, which may comprise performing queuing operations. In step **452**, the WMC device may receive data that may be forwarded to and/or from other WMC devices in the WMC mesh network **304**. In step **454**, a determination as to whether the received data may be queued may be performed. The received data may need to be queued in situations where further forwarding of the data may be either not available or not required, but it may be anticipated that such further forwarding may subsequently become possible. For example the WMC device may be deemed a potential candidate for external connectivity, wherein received data may be queued until such point that the WMC device may become communicatively coupled to an external network. In determining whether received data may be queued, the WMC device may utilize its queuing capability, substantially as described in step **408** in FIG. **4**A. In the instances that the outcome of the determination in step **454** indicates that no data should be queued, the WMC device may be incapable of queuing the received data. This may be due to plurality of factors, which may comprise internal limitations, for example lack of sufficient processing, storage, and/or power resources; or it may due to a determination that the WMC device may not be suitable for performing any further forwarding of the received data due to lack of necessary connectivity or lack of demand for the received data to be forwarded. In step **456**, the received data may be discarded, and the process may return to the READY state.

Returning to step **454**, in the instances that the outcome of the determination in step **454** indicates that data should be queued, the WMC device may be capable of queuing the received data. In step **458**, the received data may be queued in the WMC device. The received data may be stored, for example, within the WMC device storage resources until further forwarding of the queued data may subsequently become possible. The process may then return to the READY state.

Various embodiments of the invention may comprise a method and system for establishing a queuing system in a mesh network. The WMC devices **302***a*, **302***b*, **302***c*, **302***d*, and **302***e* may be enabled to communicate directly with each other when they may be located in sufficient proximity of each other to form mesh network **304**. The WMC devices **302***a*, **302***b*, **302***c*, **302***d*, and **302***e* in the mesh network **304** may form a queuing system wherein each WMC device in the mesh network **304** may queue data forwarded from and/or to other WMC devices in the mesh network **304**. The queuing system may be utilized to facilitate messaging between the WMC devices in the mesh network **304** and other WMC devices in the mesh network and/or external entities. A WMC device queuing availability may be based on a plurality of factors that may comprise processing load, storage space, power resources, and/or both internal and external connectivity of the device. An internal addressing scheme may be utilized in the mesh network **304** wherein each WMC device in the mesh network may be assigned a unique internal address. The internal addressing scheme may be utilized in queuing operations.

Another embodiment of the invention may provide a machine-readable storage, having stored thereon, a computer program having at least one code section executable by a machine, thereby causing the machine to perform the steps as described herein for establishing a queuing system in a mesh network.

Accordingly, the present invention may be realized in hardware, software, or a combination of hardware and software. The present invention may be realized in a centralized fashion in at least one computer system, or in a distributed fashion where different elements are spread across several interconnected computer systems. Any kind of computer system or other apparatus adapted for carrying out the methods described herein is suited. A typical combination of hardware and software may be a general-purpose computer system with a computer program that, when being loaded and executed, controls the computer system such that it carries out the methods described herein.

The present invention may also be embedded in a computer program product, which comprises all the features enabling the implementation of the methods described herein, and which when loaded in a computer system is able to carry out these methods. Computer program in the present context means any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following: a) conversion to another language, code or notation; b) reproduction in a different material form.

While the present invention has been described with reference to certain embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the scope of the present invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present invention without departing from its scope. Therefore, it is intended that the present invention not be limited to the particular embodiment disclosed, but that the present invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A method comprising:

establishing, by a first wireless mobile peer communication device, a connection to a mesh network that comprises wireless mobile peer communication devices when the first wireless mobile peer communication device is in operating proximity of one or more other wireless mobile peer communication devices in the mesh network;

determining, by the first wireless mobile peer communication device, availability of queuing resources within the first wireless mobile peer communication device; and

queuing, by the first wireless mobile peer communication device, data received from another wireless mobile peer communication device in the first wireless mobile peer communication device based on the determined availability of the queuing resources,

wherein the first wireless mobile peer communication device determines a first subset of the wireless mobile peer communication devices in the mesh network that can be utilized for queuing data sent from the first wireless mobile peer communication device, and determines a second subset of the wireless mobile peer communication devices in the mesh network for which the first wireless mobile peer communication device can be utilized for queuing data based on information derived, by the first wireless mobile peer communication device, from an internal addressing scheme unique to the mesh network.

2. The method of claim **1**, wherein a size limit for the data received from the another wireless mobile peer communication device that is allowed to be queued is determined based on the determined availability of the queuing resources.

3. The method of claim **1**, wherein, in the mesh network, the first wireless mobile peer communication device is enabled to serve as a relay for the other wireless mobile peer communication devices, wherein a message is routed through the mesh network, from one wireless mobile peer communication device to another wireless mobile peer communication device, until a destination is reached.

4. The method according to claim **1**, wherein a wireless mobile peer communication device connected to the mesh network is assigned a unique internal address for the mesh network.

5. The method according to claim **4**, wherein the data received from the another wireless mobile peer communication device is queued utilizing a corresponding unique internal address.

6. The method according to claim **4**, wherein the wireless mobile peer communication device is assigned a second unique internal address for a second mesh network when the wireless mobile peer communication device is connected to a second mesh network.

7. The method according to claim **1**, comprising resolving access competition while performing the queuing.

8. The method according to claim **7**, comprising performing the resolution of access competition based on priority.

9. The method according to claim **8**, wherein the priority is based on an identity of the another wireless mobile peer communication device that sent the received data.

10. The method according to claim **8**, wherein the priority comprises traffic priority based on type of the data received from the another wireless mobile peer communication device.

11. A non-transitory machine-readable storage having stored thereon computer-readable instructions that, when executed by a computer, cause the computer to execute a method comprising:

establishing a connection to a mesh network that comprises wireless mobile peer communication devices when a first wireless mobile peer communication device is in operating proximity of one or more other wireless mobile peer communication devices in the mesh network;

determining availability of queuing resources within the first wireless mobile peer communication device; and

queuing the data received from another wireless mobile communication device in the first wireless mobile peer communication device based on the determined availability of the queuing resources,

wherein the first wireless mobile peer communication device determines a first subset of the wireless mobile peer communication devices in the mesh network that can be utilized for queuing data sent from the first wireless mobile peer communication device, and determines a second subset of the wireless mobile peer communication devices in the mesh network for which the first wireless mobile peer communication device can be utilized for queuing data based on information derived, by the first wireless mobile peer communication device, from an internal addressing scheme unique to the mesh network.

12. The non-transitory machine-readable storage according to claim **11**, wherein a size limit for the data received from the another wireless mobile peer communication device that is allowed to be queued is determined based on the determined availability of the queuing resources.

13. The non-transitory machine-readable storage according to claim **12**, further comprising assigning a wireless mobile peer communication device connected to the mesh network a unique internal address for the mesh network.

14. The non-transitory machine-readable storage according to claim **13**, wherein the data received from the another wireless mobile peer communication device is queued utilizing a corresponding unique internal address.

15. The non-transitory machine-readable storage according to claim **11**, wherein the queuing resources comprise processing, storage, power, internal connectivity within the mesh network, and external connectivity outside of the mesh network.

16. A device comprising:

circuitry configured to:

establish a connection to a mesh network that comprises wireless mobile peer communication devices when the device is in operating proximity of one or more other wireless mobile peer communication devices in the mesh network;

determine availability of queuing resources within the device; and

queue data received from another wireless mobile peer communication device in the device based on the determined availability of the queuing resources,

wherein the circuitry is configured to determine a first subset of the wireless mobile peer communication devices in the mesh network that can be utilized for queuing data sent from the device, and determine a second subset of the wireless mobile peer communication devices in the mesh network for which the device can be utilized for queuing data based on information derived, by the device, from an internal addressing scheme unique to the mesh network.

17. The device according to claim **16**, wherein a size limit for the data received from the another wireless mobile peer communication device that is allowed to be queued is determined based on the determined availability of the queuing resources.

18. The device according to claim **16**, wherein the circuitry is configured to queue the data received from the another wireless mobile peer communication device utilizing a unique internal address associated with the mesh network.

19. The device according to claim **16**, wherein the queuing resources comprise processing, storage, power, internal connectivity within the mesh network, and external connectivity outside of the mesh network.

20. The device according to claim **16**, wherein, in the mesh network, the circuitry is configured to serve as a relay for the other wireless mobile peer communication devices, wherein a message is routed through the mesh network, from

one wireless mobile peer communication device to another wireless mobile peer communication device, until a destination is reached.

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